Honeywell Docket No. H0002800.34350 US- 4015
Buchalter Docket No.: H9945-3905

OK TO ENTER: /RM/

04/22/2010

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Named Inventor: **Chi Tse Wu**

Serial No: **10/759444**

Filed: **January 14, 2004**

For: **SPUTTERING TARGETS, SPUTTER REACTORS, METHODS OF FORMING CAST INGOTS, AND METHODS OF FORMING METALLIC ARTICLES**

Examiner: **Rodney G. McDonald**

Art Unit: **1795**

RESPONSE AFTER FINAL OFFICE ACTION

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Dear Sir:

This paper responds to the Final Office Action dated February 12, 2010. Please enter the following:

Claim Amendments: None – presented only for immediate reference

Remarks Section: Begins on Page 4

LISTING OF THE CURRENT CLAIMS

IN ACCORDANCE WITH REVISED AMENDMENT PRACTICE

Claims 1-66: Canceled.

67. (Previously Presented) A three-dimensional physical vapor deposition target, comprising:

a material comprising one or more of Cu, Ni, Co, Ta, Al, and Ti;

an average grain size of less than or equal to 250 microns within the material;

a shape, the shape including at least one cup having a first end and a second end in opposing relation to the first end; the first end having an opening extending therein; the cup having a hollow therein; the hollow extending from the opening in the first end toward the second end; the cup having an interior surface defining a periphery of the hollow and an exterior surface extending around the second end at rounded corners; and

a sputtering surface defined along the interior surface of the cup, wherein the target is monolithic and comprises a cast ingot.

68. (Original) The three-dimensional physical vapor deposition target of claim 67 wherein the material consists essentially of copper; and wherein the target consists essentially of the material.

69. (Original) The three-dimensional physical vapor deposition target of claim 67 wherein the material consists essentially of tantalum; and wherein the target consists essentially of the material.

70. (Original) The three-dimensional physical vapor deposition target of claim 67 wherein the material consists essentially of CuSn, with the Sn being present to from about 100 ppm, by weight, to about 3 atomic percent; and wherein the target consists essentially of the material.

71. (Original) The three-dimensional physical vapor deposition target of claim 67 wherein the material consists essentially of CuAl, with the Al being present to from about 100 ppm, by weight, to about 3 atomic percent; and wherein the target consists essentially of the material.

72. (Original) The three-dimensional physical vapor deposition target of claim 67 wherein the material consists essentially of CuAg, with the Ag being present to from about 100 ppm, by weight, to about 3 atomic percent; and wherein the target consists essentially of the material.

73. (Original) The three-dimensional physical vapor deposition target of claim 67 wherein the average grain size is less than or equal to 200 microns.

74. (Original) The three-dimensional physical vapor deposition target of claim 67 wherein the average grain size is less than or equal to 100 microns.

75. (Original) The three-dimensional physical vapor deposition target of claim 67 wherein the average grain size is less than or equal to 90 microns.

76. (Original) The three-dimensional vapor deposition target of claim 67 wherein the average grain size is less than or equal to 85 microns.

Claims 77-89: Canceled.

REMARKS

FAI LAI REFERENCE

The Applicant acknowledges that this reference has been removed from the current prosecution and thanks the Examiner for his thorough review of this case.

CLAIM REJECTIONS – 35 USC 103

Claims 67, 70 and 72-76 are rejected under 35 USC 103(a) as being unpatentable over Lu et al. (US 6471831) in view of Kardokus et al (US 611761). The Applicant respectfully disagrees.

Claim 68 is rejected under 35 USC 103(a) as being unpatentable over Lu in view of Kardokus et al (US 611761) as applied to claims 67, 70 and 72-76, and further in view of Kulkarni (US 6283357). The Applicant respectfully disagrees.

Claim 69 is rejected under 35 USC 103(a) as being unpatentable over Lu in view of Kardokus et al (US 611761) as applied to claims 67, 70 and 72-76, and further in view of Michaluk (WO 00/31310). The Applicant respectfully disagrees.

Claim 71 is rejected under 35 USC 103(a) as being unpatentable over Lu in view of Kardokus et al (US 611761) as applied to claims 67, 70 and 72-76, and further in view of Pavate et al. (US 6391163). The Applicant respectfully disagrees.

Claim 71 is rejected under 35 USC 103(a) as being unpatentable over Lu in view of Kardokus et al (US 611761) as applied to claims 67, 70 and 72-76, and further in view of Pavate et al. (US 6391163). The Applicant respectfully disagrees.

Claim 67 recites:

"A three-dimensional physical vapor deposition target, comprising:

a material comprising one or more of Cu, Ni, Co, Ta, Al, and Ti;

an average grain size of less than or equal to 250 microns within the material;

a shape, the shape including at least one cup having a first end and a second end in opposing relation to the first end; the first end having an opening extending therein; the cup having a hollow therein; the hollow extending from the opening in the first end toward the second end; the cup having an interior surface defining a periphery of the hollow and an exterior surface extending around the second end at rounded corners; and

a sputtering surface defined along the interior surface of the cup, wherein the target is monolithic and comprises a cast ingot." (emphasis added)

First, however, the original specification discusses in paragraph 0006 why it is so difficult to fabricate complex three dimensional targets, such as the Applied Materials, Novellus and/or Honeywell three dimensional targets. The manufacture of these targets cannot be analogized to the manufacture of a two-dimensional target in any way. It is just not appropriate to consider the Kardokus reference as analogous art in this case, because of this very reason – it is difficult and not intuitive to manufacture a three-dimensional target. Methods utilized at the time of the filing date of the current application just were not the same as those methods being utilized to construct conventional three dimensional targets. One of the biggest issues was the inability to get the grain size of the materials in a three dimensional target down to the levels seen in two dimensional targets of the same materials. At the time this application was filed – there was no appreciation or understanding in the art as to how that could be done.

The original specification discusses the issue of the average grain size within the material (see paragraph 0013). Specifically:

> "The improvement in deposited film uniformity that can be achieved with materials having smaller grain sizes has led to a desire to incorporate small grain size materials into the sputtering targets. It is found that small grain size materials can be formed within two-dimensional sputtering targets simply by subjecting the target materials to high compression during formation of the materials. Since the two-dimensional targets are essentially flat, high-compression technology can be readily incorporated into the processes of forming two dimensional targets. In contrast, it has proven difficult to form three dimensional targets having small grain sizes therein. It would be particularly desired to form monolithic copper targets having the complex geometries of the Fig. 2 and Fig. 4 target shapes, while also having a small average grain size."

All of the claims of the current application contain the provision that the average grain size is less than or equal to 250 microns within the material, by virtue of their dependency on independent claim 67.

The Examiner did not point to any portion of the Lu disclosure that states that the targets have a small grain size. In fact, the Examiner uses Kardokus to supposedly show how grain size modification is obvious; however, as has already been discussed – the technology used to produce low grain sizes in two dimensional targets does not directly or intuitively translate to the formation of three-dimensional targets. Therefore, it stands to reason that one would not read Lu and consider this application, alone or in combination with Kardokus, to produce the claims of the current application at the time this application was filed.

Kardokus does not cure the obvious deficiencies of Lu, specifically the issue of a three dimensional target, because Kardokus does not disclose a three-dimensional target, as is disclosed in the present application. The Examiner is invited to review the original specification – paragraph [0013], which discusses the inherent differences in Kardokus and

the current application. Therefore, claim 67 is considered allowable, along with the related dependent claims, in view of Lu and/or Kardokus.

The Examiner also takes issue with the inclusion of a "cast ingot" in claim 67. The cast ingot is a piece of material that the three-dimensional target is made from. There is no product-by-process issue here, because the material is what it is – a cast ingot.

The Kulkarni reference discloses a clad hollow cathode magnetron sputter target that is made from a plate of sputter target material and a sheet of cladding material. Kulkarni specifically explains that the benefit of the Kulkarni disclosure is that it solves the problems inherent with monolithic targets, including cost and weight (see Abstract, among other sections). The present application, including the independent claims, covers targets that are produced from ingots and cast ingots that are ultimately formed into monolithic targets, which is exactly the opposite of Kulkarni. The Examiner clearly should not be citing this reference, because it teaches away from a monolithic target and as a matter of fact, spends a great deal of space discussing their inferiority.

Michaluk and Pavate do not cure the obvious deficiencies of Lu, Kardokus, alone or in combination with one another, because they do not teach, disclose or motivate one of ordinary skill in the art to produce a three-dimensional target that is both monolithic and comprises an average grain size of less than or equal to 250 microns within the material.

Therefore, claim 67 is considered allowable, along with the related dependent claims, in view of Lu, Michaluk Pavate and/or Kardokus. In addition, dependent claims 68-76 are allowable by virtue of their dependency on independent claim 67.

REQUEST FOR INTERVIEW

While the Applicants believe that this response puts the application in condition for allowance, the undersigned attorney of record respectfully requests an opportunity to discuss this case with the Examiner, if the Examiner has additional objections or questions or if the Examiner would like to further discuss any of the cited references. Dr. Thompson would like this opportunity prior to issuance of an Advisory Action, so that this case can be expedited without the need for additional written office actions and responses. A request for an interview is attached herein just in case the Examiner needs to discuss additional issues with Dr. Thompson.

REQUEST FOR ALLOWANCE

Claims 67-76 are pending in this application and the Applicant respectfully requests that the Examiner reconsider all of the claims in light of the arguments presented and allow all current and pending claims.

Respectfully submitted,

Buchalter Nemer, A Professional Corp.

Dated: April 12, 2010

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